New York, New Haven and Hartford
Railroad, Groton Bridge
(Thames River Bridge)
(Northeast Corridor Project)
Spanning The Thames River between
New London (and Groton)
New London County
Connecticut

HAER No. CT-25

HAER
CONN,
6-NEWLO,
11-

PHOTOGRAPHS

WRITTTEN HISTORICAL AND DESCRIPTIVE DATA

HISTORIC AMERICAN BUILDINGS SURVEY
MID-ATLANTIC REGION NATIONAL PARK SERVICE
DEPARTMENT OF THE INTERIOR
PHILADELPHIA, PENNSYLVANIA 19106

HISTORIC AMERICAN ENGINEERING RECORD

HAER
CONN,
6-NEWLO,
11-

Index to Photographs

New York, New Haven and Hartford Railroad, Groton Bridge
(Thames River Bridge)
(Northeast Corridor Project)

HAER No. CT-25

Location:	Spanning the Thames River between New London and Groton, New London County, Connecticut UTM Coordinates: 18.743640.4582930 USGS Quadrangle: New London
Date of Construction:	1917-1919
Present Owner:	National Railroad Passenger Corporation Suburban Station Building 1617 John F. Kennedy Boulevard Philadelphia, Pennsylvania 19103
Present Use:	Railroad bridge
Significance:	The Groton Bridge is a Strauss heel trunnion bascule bridge. It is significant as part of the transportation link in the shoreline route of the New York, New Haven and Hartford Railroad, and as an individual engineering solution to the need to provide dependable rail service while accommodating river navigation.
Project Information:	The Groton Bridge is to be rehabilitated as part of the Northeast Corridor Improvement Project. Under Section 106 of the National Historic Preservation Act of 1966, mitigative documentation was undertaken in April 1983 for the Federal Railroad Administration by historian Janice G. Artemel, with the assistance of Lisa Crye, Ellen Gallagher, and Kristin Heintz.

The national railway network that was to be one of the critical catalysts in the industrialization of the United States was largely completed between 1840 and 1880. Most early railroads were short lines that attempted to tap economic resources of the hinterlands of cities. By the second quarter of the 19th century, cities east of the Mississippi, particularly those in the northeast, began to build longer lines and consolidate shorter ones to tie them more closely together.[1] The New York, New Haven and Hartford Railroad provides an excellent example of how railroad systems were created and how they advanced transportation technology, including movable bridges, with their economic power.

The New York, New Haven and Hartford Railroad was first formed by a consolidation of the Hartford and New Haven Railroad Company with the New York & New Haven Company, when the two railroads entered into a partnership agreement. The capital was divided, and the New York, New Haven & Hartford Railroad was established on August 6, 1892.[2] Lengthy and intricate patterns of acquisiton were common to railroading in the late 19th century. Empires were created as well as monopolies on the transportation of goods. The peak growth years of the American railroads were the early 1900s and, of those, the teens (1911-1919) were the final surge. The decline of the railroads after those years was due partly to the excesses of transportation monopolies in the last quarter of the 19th century and partly to a combination of rising costs and competition from other modes of transportation.[3]

By the end of the 19th century, the New York, New Haven and Hartford Railroad extended from New York to Boston and virtually controlled rail traffic in southern New England, effectively preventing any further major competition along its lines.[4] It then set about to secure its hold with a building program, which occurred mostly between 1911 to 1919. Construction and railroad technologies had advanced to the point that massive quantities of earth and rock could be moved and placed elsewhere; bridges were raised above streets and crossed rivers where bridges had not been possible before. The expenditures were prime examples of the growing capability of an industrialized society to engage in large scale environmental manipulation.[5]

Movable Bridge Types and Technological Developments

Of special significance in the development of railroad technology during this period were the many new bridges built over major water courses, including movable bridges. A movable bridge can be changed in position to allow continued river traffic. There are three types of movable bridges: the swing bridge, in which the movable span turns on a pivot pier; the bascule bridge, which in modern form uses a counterweight to raise one end of the movable span and lift the bridge; and the lift bridge, in which the movable span is actually raised between two towers to open the bridge.

The earlier records of movable iron railway bridges in the United States show the use of the rim-bearing swing type. Among the earliest were a series of parallel swing bridges built across the Charles River in Boston in the early 19th century, which were timber trusses hinged at one end which swung open to allow a narrow channel for navigation.[6] In the 1860's many of the rim-bearing swing type were built in the Mississippi Valley. Design of the center-bearing swing bridge, which is superior to the rim-bearing in many aspects, was improved greatly between the late 18,80's and 1900. After 1900, strong advocacy by C. C. Schneider, a consulting engineer for the American Bridge Company, influenced many engineers to use the center bearing swing bridge. The modern bascule and lift bridge types were not developed until after 1890, when the electric motor was refined and a method of counter-balancing the weight of a large span had been developed.[7]

Along the eastern seaboard, the large number of navigable rivers and inlets to be crossed resulted in the construction of 15 movable bridges on what is today the Northeast Corridor rail line: nine bascule bridges, five swing bridges, and one vertical lift bridge. Generally, swing bridge types were preferred over bascule and lift bridges when the waterway was wide enough to allow for clearance on either side. When the waterway was too narrow to provide clearance, as is often the case in the northeast, vertical lift or bascule bridges were used. Bascule bridges are difficult to maintain and repair and present clearance problems for tall vessels since they cannot be opened to a full 90-degree angle. However, they can be opened and closed more rapidly than swing bridges, which is an advantage to rail operations. Vertical lift bridges also present clearance problems for tall vessels, although they do not need as much maintenance and repair as bascule spans.

Four movable bridges built by the New York, New Haven & Hartford Railroad at Niantic, Shawls Cove, Groton and Mystic, Connecticut are typical examples of engineering practices in the early part of the 20th century. Examination of their engineering and use illustrates this. These four are all shoreline bridges, within 16 miles of each other (Figure 1). Niantic and Groton are bascule bridges, Shawls Cove is a rim-bearing swing bridge, and Mystic is a center-bearing swing bridge. Each bridge was designed for its location and with particular attention to intended function and possible problems. The bridges were prefabricated at the construction company's plant and then built by unskilled labor at the site. The machinery to operate the bridges was not standardized and each bridge has unique mechanical components.

These bridges reflect the state-of-the-art technology of movable bridges in the period from 1907-1919. Because steamship lines covered Long Island Sound during the 19th century, impetus for completing a through shoreline rail route from New Haven to Boston developed relatively late in the history of New England railroads. Two other rail routes, the Willimantic, Providence and Boston line, and the Springfield line to Hartford, Connecticut and Springfield, Massachusetts, provided connections between New Haven and Boston that were approximately the same distance in rail miles. It was not until 1889 that an all rail shoreline route was completed. At about the same time, the technology of removable bridges was being greatly advanced. As the older bridges on the shoreline route deteriorated and became outmoded by the need to carry heavier and faster rail traffic along the shoreline route, they were replaced with new movable bridge representative of bridge technology of the day.

Groton Bridge

Northeast of New London and Shaw's Cove is another New York, New Haven and Hartford Railroad bridge over the Thames River at Groton. Constructed in 1918, Thames River or Groton Bridge is a Strauss heel trunnion bascule bridge designed by the engineering department of the New York, New Haven and Hartford Railroad, under the direction of Edward Gagel, Chief Engineer; I. D. Waterman, Construction Engineer; and W. H. Moore, Bridge Engineer. The plans and specifications for the moveable span were prepared by the Strauss Bascule Bridge Company, Consulting Engineers, Chicago, Illinois. Consulting engineering services were provided by E. A. McHenry, J. P. Snow, and two of America's foremost bridge engineers, Gustav Lindenthal and Ralph Modjeski. Holbrook, Cabot and Rollins of Boston constructed the substructure, the American Bridge Company fabricated and erected the superstructure, and C. H. Norwood, Contracting Electrical and Mechanical Engineering of Chicago, installed the air, electric and gas engine equipment.

The Strauss bascule was developed about the same time as the Scherzer rolling lift. Patented by Joseph B. Strauss, the first Strauss was completed in 1905. There are three basic types of Strauss bridges: the vertical overhead counterweight type, the underneath counterweight, and the heel trunnion. Groton Bridge is the only heel trunnion type of Strauss bascule bridge on the Northeast Corridor rail line.

Groton Bridge has five double-track, through truss spans. From west to east, it consists of two Pratt truss spans, 185 feet and 330 feet long, respectively; a Warren truss bascule span, 212 feet long; and two more Pratt truss spans, each 300 feet long. From the front face of the west abutment to the front face of the west abutment, the bridge is 1,394 feet long.[8] Structural members carrying live loads are made of structural silicon steel. The bridge has a 25-foot clearance above mean high water. When opened, the through truss rotates about trunnions at the bottom chord of the trusses. The overhead counterweight is attached to the moving span and a fixed tower at the rear break by a parallelogram arrangement of the struts. As the moving leaf rises, the trunnion folds, causing the counterweight to move downward. Because the parallelogram of struts folds as the bridge lifts, the bridge is maintained in balance throughout operation.

The gearing terminates at two drive pinions, engaging the rack attached to the operating struts. These operating struts are attached by trunnions to the top chord of the trusses. As the drive pinion moves the rack and operating strut, the bridge rotates about the heel trunnion.

The bridge machinery is located in a house on the fixed span between the fixed trusses. Four 82-horsepower, 44-volt, 3-phase, 60 cycle A.C. wound rotor motors are geared together to provide power in simultaneous pairs, west of the movable span, above and behind the rear floor break.

The drive trains are provided with an equalizer assembly between the final reduction gears. One auxiliary 40-horse-power motor is in the machinery house. Each double-shgafted motor is fitted with a solenoid brake for regular use, and a pneumatic emergency brake is provided on each operating strut.

The bridge lock linkage,, with motor drive and gear trains, is located below track level at the toe of the bridge. There is a bevel gear set for manual opration. Mitre rails are located at both the heel and toe of the bridge with rail alignment guides. Sliding rail locks driven by electric motors and linkages are at both ends of the bridge.

Power for bridge operation is supplied upon request from the bridge operator to the signal tower. The electrical switchgear and controls are in the operator's house and the lower level of the machinery house. The two-level operator's house is adjacent to the northbound track at the rear floor break.

In the early 1880s, construction of the bridge at this location had been considered beyond the engineering technology of the day. The river at the point the bridge was needed was about 1,400 feet wide. The water ws 50 feet keep at the center of the river, and rock bottom was 100 to 180 feet below water level.

Although a bridge, built here in 1889, employed the best engineering techniques of the day, shortly after it went into service, pier No. 1 on the west end began to settle. By 1905, the bridge had began to move. At that time, the bridge was considered unsafe for engines weighing over 157,000 pounts, and 100,000-pound cars, loaded to full capacity, were not allowed to pass over the bridge, a hindrance to economical train movement.[9] In 1908, some of the piers had settled to such an extent that traffic was cut to a single gauntleted track. Thus, when studies were conducted for a new bridge, there was considerable concern for the new bridge's stability.

Studies were made of the river bottom and possible foundations for the piers. James Rollins of Holbrook, Cabot & Rollins investigated several alternatives, finally settling on a plan for rectangular open crib caissons. This method of building piers was expensive and time-consuming, but the railroad was convinced it was advantageous, in view of the desired stability. The work on the foundation was begun in April 1916 and finished in August 1918.[10] The piers were designed to accommodate four tracks, but only two were ever needed.

Problems of superstructure design also had to be confronted early. However, the bascule design was chosen, mostly because of considerations for pier stability. A swing bridge is necessary only when two channels of equal width are desired. It requires less power to open and close, but involves more structure and, therefore, more weight. Because a bascule span has less structure, it is also less expensive to built. But since the primary concern of the railroad was the stability of the bridge on its piers, it may be assumed that the weight of the superstructure was the deciding factor in choosing a bascule span. The superstructure was completed in 1919.

FOOTNOTES

1 Alfred D. Chandler, "The Beginnings of 'Big Business' in American Industry," Business History Review 33 (Spring 1959): 1-31.

2 George Pierce Baker, Formation of the New England Railroad Systems (New York: Greenwood Prass, 1968), p. 1.

3 John L. Weller, The New Haven Railroad: Its Rise and Fall (New York: Hastings House, 1969).

4 R. Patrick Stanford, Lines of the New York, New Haven & Hartford Railroad Co. (Stanford: Stanford University Press, 1979).

5 Weller.

6 David Plowden, Bridges - The Spans of North America (New York: The Viking Press, 1974)

7 Plowden

8 James W. Rollins, "Thames River Bridge," Journal of the Boston Society of Civil Engineers 7 (June 1920): 177-179.

9 "Improvements on the New York, New Haven & Hartford," The Railroad Gazette 38 (March 17, 1905): 242-246.

10 Rollins.

BIBLIOGRAPHY

Baker, George Pierce. Formation of the New England Railroad System. New York: Greenwood Press, 1968.

Chandler, Alfred D. "The Beginnings of 'Big Business' in American Industry," Business History Review 33 (Spring 1959): 1-31.

Connecticut Gazette. Published 1873-1909.

Decker, Robert Owen. The Whaling City. Chester, Connecticut: Pequot Press, 1976.

"Improvements on the New York, New Haven & Hartford." The Railroad Gazette 38 (March 17, 1905): 242-246.

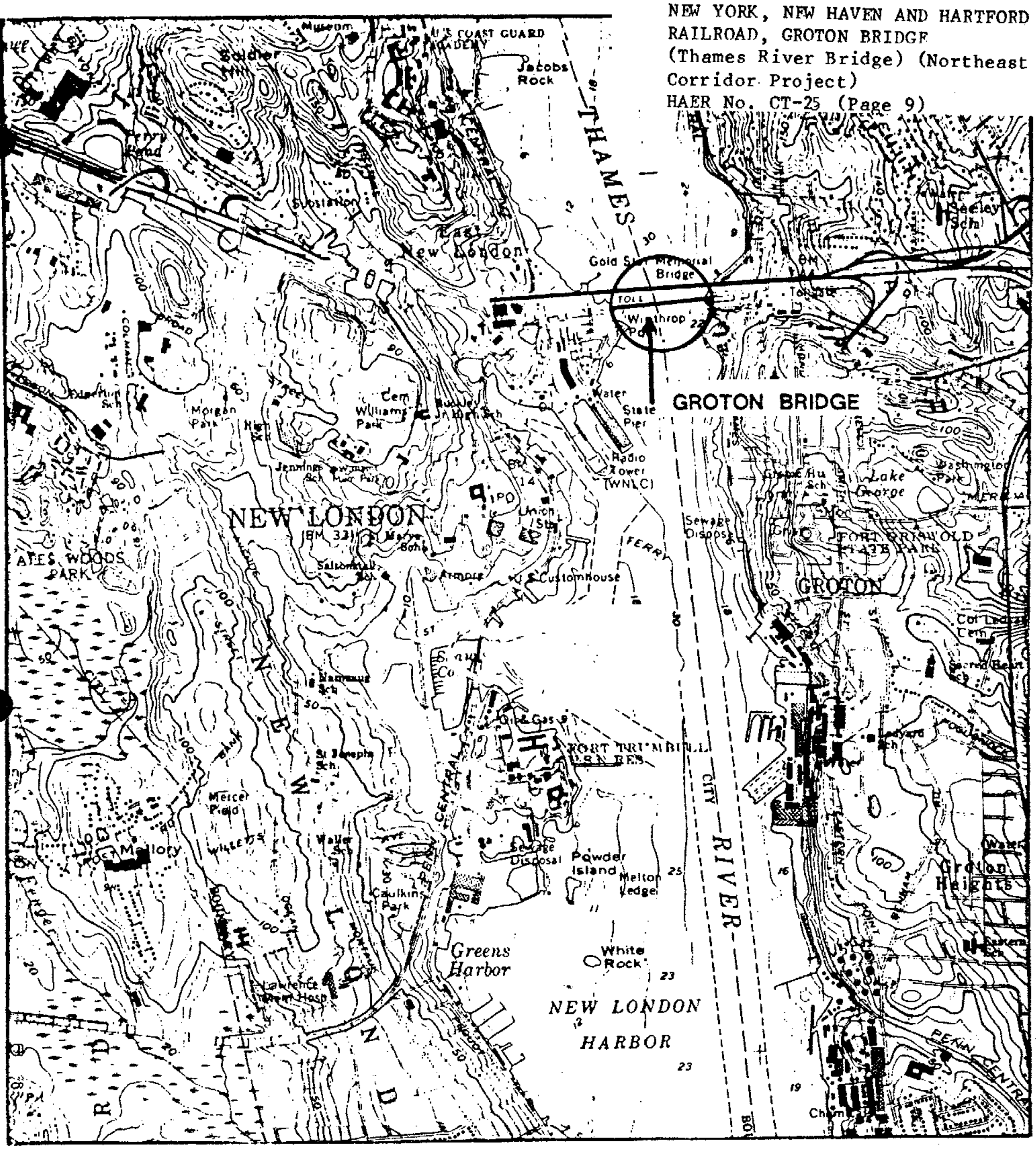
Plowden, David. Bridges - The Spans of North America. New York: The Viking Press, 1974.

Rollins, James W. "Thames River Bridge," Journal of the Boston Society of Civil Engineers 7 (June 1920): 177-199.

Stanford, Patrick R. Lines of the New York, New Haven & Hartford Railroad Co. Stanford: Stanford University Press, 1976.

Weller, John L. The New Haven Railroad: Its Rise and Fall. New York: Hastings House, 1969.

NEW YORK, NEW HAVEN AND HARTFORD
RAILROAD, GROTON BRIDGE
(Thames River Bridge) (Northeast
Corridor Project)
HAER No. CT-25 (Page 9)



Groton/New London Conn.		Northeast Corridor Improvement Project Federal Railroad Administration, Department of Transportation
UTM Reference 18/743640/4582930	SCALE 1:24,000	HISTORIC SITES MAP Cultural Resources